Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. If A is a square matrix of order 5 with $A^{-1} = A^T$ and non-negative determinant, then the determinant of A is _____.

(A) 0 (B) 1
(C) 2 (D) 5

2. For two matrices A and B, if $AB = A$ and $BA = B$, then which of the following statements is/are correct?

I. A is an idempotent matrix.
II. B is an idempotent matrix.

(A) I only
(B) II only
(C) Both I and II
(D) Neither I nor II

3. Consider the matrix $A = \begin{bmatrix} 1 & a & bc \\ 1 & b & ca \\ 1 & c & ab \end{bmatrix}$. Which of the following is NOT equal to the determinant of A?

(A) $\begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix}$ (B) $\begin{vmatrix} a+bc & a & 1+a \\ b+ca & b & 1+b \\ c+ab & c & 1+c \end{vmatrix}$

(C) $\begin{vmatrix} 0 & a-b & bc-ac \\ 0 & b-c & ca-ab \\ 1 & c & ab \end{vmatrix}$ (D) $\begin{vmatrix} 1 & a+1 & a^2+a \\ 1 & b+1 & b^2+b \\ 1 & c+1 & c^2+c \end{vmatrix}$

4. For a non-singular square matrix A, if $A^3 = A$, then A must be _____.

(A) a nilpotent matrix
(B) an idempotent matrix
(C) an involutory matrix
(D) None of these

5. If A is a matrix of order 6×9 with rank 5, then which of the following is true?

(A) All the rows of A are linearly independent.
(B) 5 columns of A are linearly independent.
(C) AA^T is invertible.
(D) A^TA is invertible.

6. The rank of the matrix $P = \begin{bmatrix} 1 & 2 & 4 & -3 \\ 2 & -3 & 5 & -4 \\ 4 & 1 & 13 & -10 \\ 3 & -8 & 6 & -5 \end{bmatrix}$ is _____.

(A) 1 (B) 2
(C) 3 (D) 4

7. The value of x_3 in the solution of the system of linear equations $x_1 + 2x_2 + 2x_3 = 4$, $2x_1 - 2x_2 - x_3 = -3$, $4x_1 + x_2 + 2x_3 = 3$ is —

(A) 1 (B) −1
(C) 2 (D) −2

8. For a homogeneous system of linear equations $AX = O$ with four equations in four unknowns, if the number of linearly independent solutions is one, then the rank of A is _____.

(A) 1 (B) 2
(C) 3 (D) 4

9. If $A = \begin{bmatrix} 1 & 10 & 16 & -20 \\ 0 & -1 & 159 & 237 \\ 0 & 0 & 1 & -431 \\ 0 & 0 & 0 & 1 \end{bmatrix}$; then the determinant of $A^9 - 7A^5 + 4A$ is _____.

(A) 4 (B) −4
(C) 16 (D) −16

10. If the characteristic equation of a 2×2 matrix A is $\lambda^2 - 4\lambda + 1 = 0$, then the trace and determinant of A respectively are _____.

(A) −1 and 4 (B) 1 and −4
(C) 4 and 1 (D) 4 and −1

11. If λ_1 and λ_2 are the eigenvalues of a 2×2 non-singular matrix A, then the eigenvalues of ad joint of A are _____.

(A) λ_1 and λ_2 (B) λ_1^2 and λ_2^2
(C) $\lambda_1 + \lambda_2$ and $\lambda_1 - \lambda_2$ (D) $\lambda_1 \times \lambda_2$ and $\frac{\lambda_1}{\lambda_2}$

12. If A is a 3×3 matrix with the characteristic equation $\lambda^3 - 5\lambda^2 + 2\lambda - 3 = 0$, then $3A^9 - 15A^8 + 6A^7 - 11A^6 + 10A^5 - 4A^4 + 10A^3 - 20A^2 + 8A - 9I$ is equal to _____.

(A) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$

(C) $\begin{bmatrix} 3 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ (D) $\begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$

13. Which of the following is NOT an eigenvector of the matrix $A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 3 & 0 \\ 3 & -1 & 4 \end{bmatrix}$?

(A) $\begin{bmatrix} 3 \\ -3 \\ -4 \end{bmatrix}$ B) $\begin{bmatrix} 0 \\ 0 \\ -4 \end{bmatrix}$

(C) $\begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$ (D) $\begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix}$

14. If the system of linear equations
$2x + 3y + 4z = 1$
$5x - y + z = 4$
$3x + ay - 3z = 3$
has a unique solution, then the value of $a + 4$ _____
(A) must be equal to 0,
(B) should not be equal to 0
(C) can be any real number,
(D) can be any rational number

15. If a_1, b_1, c_1, d_1, a_2, b_2, c_2 and d_2 are any non zero real numbers, then which of the following types of solution is NOT possible for the system of linear equations.
$a_1x + b_1y + c_1z = d_1$
$a_2x + b_2y + c_2z = d_2$
(A) Unique solution
(B) No solution
(C) Infinitely many solution
(D) None of these

16. The partial differential equation of $z = f(x + at) - g(x - at)$ is _____.

(A) $\frac{\partial^2 z}{\partial t^2} = a^2 \frac{\partial^2 z}{\partial x^2}$ (B) $\frac{\partial z}{\partial t} = a\frac{\partial z}{\partial x}$

(C) $\frac{\partial^2 z}{\partial t^2} = \frac{\partial^2 z}{\partial x^2}$ (D) $\frac{\partial^2 z}{\partial t^2} + \frac{\partial^2 z}{\partial x^2}$

17. The first order partial differential equation by eliminating the arbitary function from $z = f(x^3 - y^3)$ is
(A) $p + q = 0$ (B) $yp + xq = 0$
(C) $y^2p + x^2q = 0$ (D) $2y^2p + 3x^2q = 0$

18. The general solution of the partial differential equation $x^3(y - z)p + y^3(z - x)q = z^3(x - y)$ is

(A) $\phi\left(xyz, \frac{1}{x} + \frac{1}{y} + \frac{1}{z}\right) = 0$

(B) $\phi\left(\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2}, \frac{1}{x} + \frac{1}{y} + \frac{1}{z}\right) = 0$

(C) $\phi\left(\frac{1}{x} - \frac{1}{y} - \frac{1}{z}, \frac{1}{x^2} + \frac{1}{y^2} - \frac{1}{z^2}\right) = 0$

(D) $\phi\left(\frac{1}{x^2} - \frac{1}{y^2} - \frac{1}{z^2}, \frac{1}{x} - \frac{1}{y} + \frac{1}{z}\right) = 0$

19. The solution of the partial differential equation $xy^2z^2p + x^2yz^2q = x^2y^2z$ is
(A) $x^2 + y^2 = \phi(x^2 - y^2)$
(B) $x^2 + z^2 = \phi(x^2 - z^2)$
(C) $x^2 - y^2 = \phi(y^2 - z^2)$
(D) $y^2 - z^2 = \phi(x^2 - y^2 - z^2)$

20. The solution of $(p - q)(z - xp - yq) = 1$ is _____

(A) $z = ax - by + \frac{1}{a+b}$ (B) $z = ax - by$

(C) $z = ax + by$ (D) $z = ax + by + \frac{1}{a-b}$

21. If $u(x, y) = X(x).Y(y)$ be the solution of the partial differential equation $4\frac{\partial u}{\partial x} + 5\frac{\partial u}{\partial y} = 0$, which is obtained by solving it by the method of separation of variables, then $X(x)$ (the function of x only in $u(x, y)$) is _____
[Note: Here c and k are arbitrary constants]

(A) $X(x) = ce^{(kx)}x^2$ (B) $X(x) = ce^{\left(\frac{4k}{x}\right)}$

(C) $X(x) = ce^{\left(\frac{k}{4}\right)x}$ (D) $X(x) = ce^{(-5k)}x^2$

22. Which of the following second order partial differential equations is an elliptic equation?

(A) $3\frac{\partial^2 u}{\partial x^2} + 4\frac{\partial^2 u}{\partial x \partial y} - 5\frac{\partial^2 u}{\partial y^2} + 7\frac{\partial u}{\partial x} - \frac{\partial u}{\partial y} = 7x^2$

(B) $3\frac{\partial^2 u}{\partial x^2} - 4\frac{\partial^2 u}{\partial x \partial y} + 5\frac{\partial^2 u}{\partial y^2} - \frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 6x^2y$

(C) $-3\frac{\partial^2 u}{\partial x^2} + 4\frac{\partial^2 u}{\partial x \partial y} + 5\frac{\partial^2 u}{\partial y^2} + 4x\frac{\partial u}{\partial x} - 7y\frac{\partial u}{\partial y} = 0$

(D) $\frac{\partial^2 u}{\partial x^2} + 2\frac{\partial^2 u}{\partial x \partial y} + \frac{\partial^2 u}{\partial y^2} - 2\frac{\partial u}{\partial x} + 5\frac{\partial u}{\partial y} = 6xy^2$

23. The Fourier cosine series of the function $f(x) = \frac{1}{2}$, $0 \le x \le 1$ is
(A) 1 (B)
(C) 0 (D)

24. The Fourier series of $f(x) = e^{2x}$ in the $\frac{1}{4}\frac{a_0}{2}$ interval $(0, 2\pi)$ is

$f(x) = + \sum_{n=1}^{\infty} a_n \cos nx + \sum_{n=1}^{\infty} b_n \sin nx$, then the value of $\frac{a_0}{2}$ is

(A) $\frac{e^{4\pi} - 1}{4\pi}$ (B) $\frac{e^{2\pi} - 1}{2\pi}$

(C) $\frac{e^{4\pi} - 1}{2\pi}$ (D) $\frac{e^{2\pi} - 1}{4\pi}$

25 Which measurements could represent the side lengths in feet of a right triangle?

A 10 ft, 24 ft, 26 ft

B 14 ft, 14 ft, 14 ft

C 3 ft, 3 ft, 18 ft

D 2 ft, 3 ft, 5 ft

26 The table shows the coordinates of the vertices of pentagon *ABCDE*.

x	y
−1	1
1	6
4	1
2	−5
−6	−2

Pentagon *ABCDE* is dilated by a scale factor of $\frac{7}{3}$ with the origin as the center of dilation to create pentagon $A'B'C'D'E'$. If (x, y) represents the location of any point on pentagon *ABCDE*, which ordered pair represents the location of the corresponding point on pentagon $A'B'C'D'E'$?

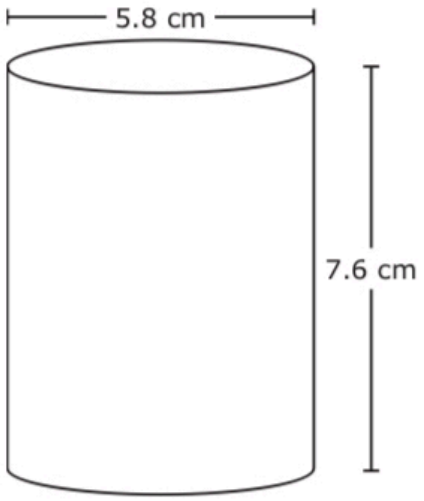
F $(\frac{3}{7}x, \frac{3}{7}y)$

G $(x+\frac{7}{3}, y+\frac{7}{3})$

H $(x+\frac{3}{7}, y+\frac{3}{7})$

J $(\frac{7}{3}x, \frac{7}{3}y)$

27 The dimensions of a cylinder are shown in the diagram.



Which measurement is closest to the lateral surface area in square centimeters of the cylinder?

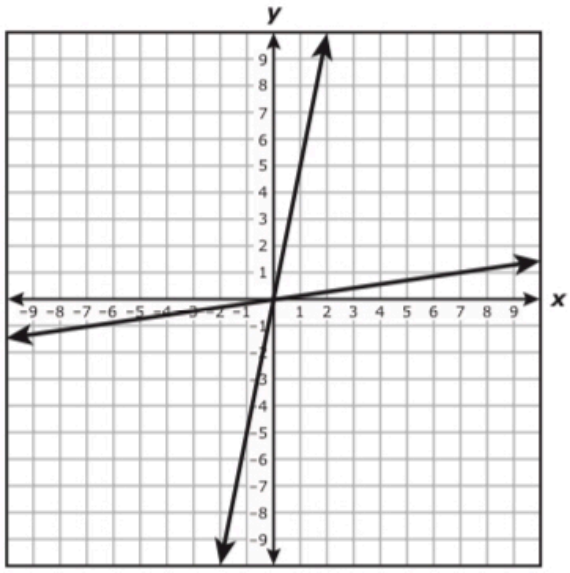
A 164.9 cm^2

B 277.0 cm^2

C 138.5 cm^2

D 191.3 cm^2

28 The two lines graphed on the coordinate grid represent a system of equations.



What is the x-coordinate of the ordered pair that best represents a solution to both equations?

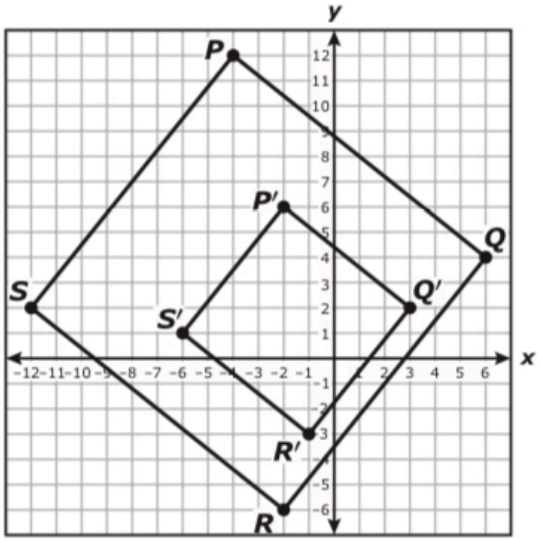
F $\frac{1}{7}$

G 0

H 5

J 7

29 Quadrilateral *PQRS* is dilated with the origin as the center of dilation to create quadrilateral *P′Q′R′S′*. The coordinates of each vertex are integers.



Which statement is true?

A Each side length of quadrilateral *PQRS* is $\frac{1}{2}$ the corresponding side length of quadrilateral *P′Q′R′S′*.

B Quadrilateral *P′Q′R′S′* is congruent to quadrilateral *PQRS*.

C Each angle measure of quadrilateral *PQRS* is $\frac{1}{2}$ the corresponding angle measure of quadrilateral *P′Q′R′S′*.

D Quadrilateral *P′Q′R′S′* is similar to quadrilateral *PQRS*.

30 The list shows the weight in pounds of 6 puppies at birth.

3, 1.6, 2.8, 2.5, 1.7, 2.8

What is the mean absolute deviation of these numbers?

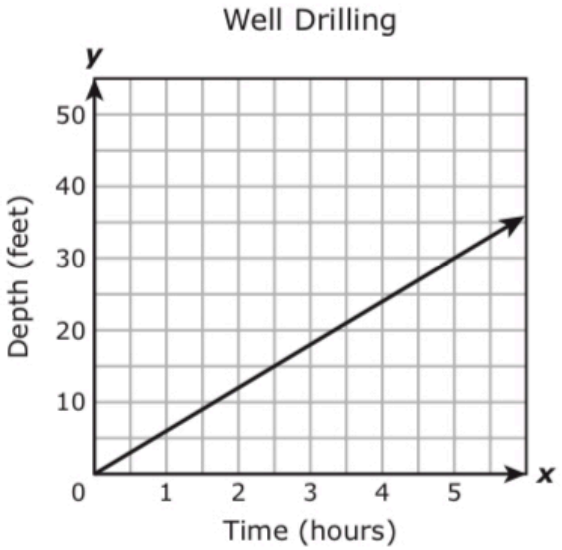
F 0.5

G 2.4

H 1.9

J 14.4

31 A company is drilling a water well. The graph models the linear relationship between the depth of the well and the time spent drilling.



Which function best represents the relationship between y and x?

A $y = 6x$

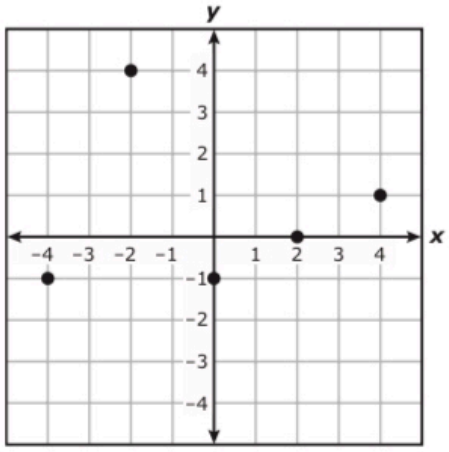
B $y = 30x$

C $y = 5x + 30$

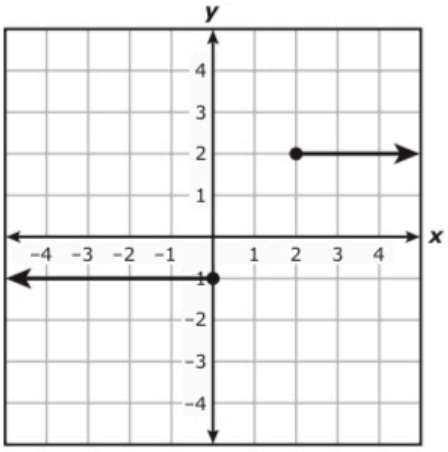
D $y = 6x + 30$

32 Which graph does NOT represent y as a function of x?

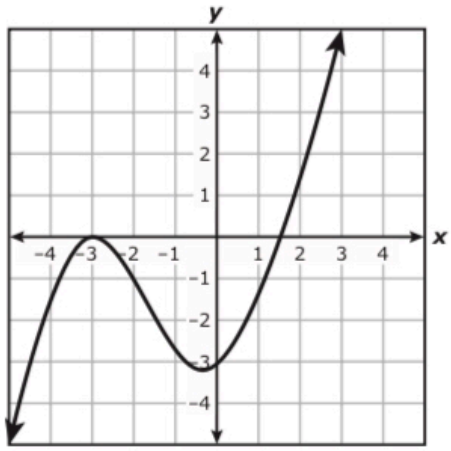
F



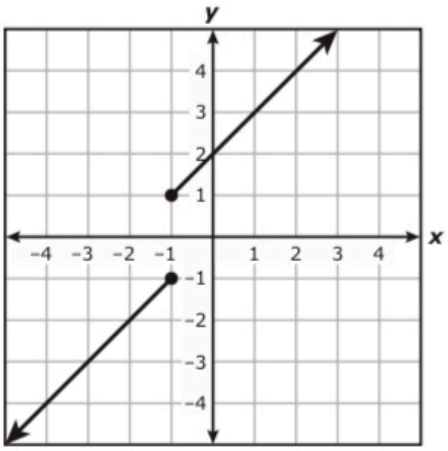
H



G



J



---

33 Mount Fuji in Japan can be modeled as a cone with a diameter of 25 miles and a height of 2.35 miles. Which measurement is closest to the volume of Mount Fuji in cubic miles?

A 1,154 mi^3

B 385 mi^3

C 1,538 mi^3

D 72 mi^3

34 A new refrigerator comes packaged in a box shaped like a rectangular prism. The base of the box measures 4 feet by 5 feet. The total surface area of the box is 148 square feet.

What is the height of the box in feet?

Record your answer and fill in the bubbles on your answer document. Be sure to use the correct place value.

---

35 Two student groups went to an amusement park on the same day.

- Group 1 bought 9 tickets and received a $120 discount.
- Group 2 bought 3 tickets and received a $30 discount.
- Both groups spent the same total amount of money on tickets.
- The price of each ticket was the same.

What was the cost of each ticket?

A $25

B $12.50

C $15

D $7.50

36 Which set of ordered pairs represents y as a function of x?

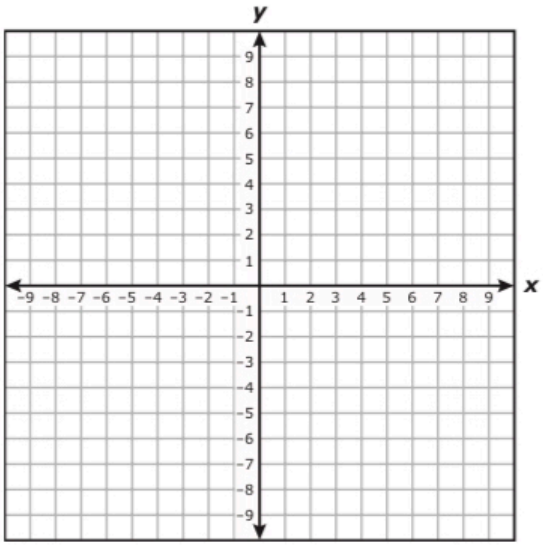
F $\{(4, \sqrt{17}), (2, \sqrt{6}), (1, \sqrt{3}), (1, \sqrt{10})\}$

G $\{(-7, 2.9), (-15, 5.9), (-15, 8.9), (-7, 11.9)\}$

H $\{(11.1, 7), (5.1, 4), (12.1, 5), (6.1, 7)\}$

J $\{(\sqrt{1}, -3), (\sqrt{2}, -4), (\sqrt{1}, -5), (\sqrt{6}, -7)\}$

37 The coordinates of the vertices of triangle XYZ are $X(-2, -1)$, $Y(6, 8)$ and $Z(8, 4)$. Triangle XYZ is dilated by a scale factor of $\frac{3}{2}$ with the origin as the center of dilation to create triangle $X'Y'Z'$.



If (x, y) represents the location of any point on triangle XYZ, which ordered pair represents the location of the corresponding point on triangle $X'Y'Z'$?

A $(\frac{3}{2}x, \frac{3}{2}y)$

B $(x+\frac{3}{2}, y+\frac{3}{2})$

C $(\frac{2}{3}x, \frac{2}{3}y)$

D $(x+\frac{2}{3}, y+\frac{2}{3})$

38 Larry put $1,287 into a savings account 8 years ago.

- The account earned 4% simple annual interest.
- He made no additional deposits or withdrawals.

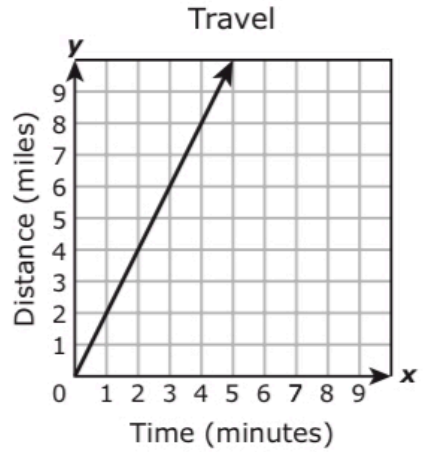
Based on this information, what is the balance in dollars and cents in Larry's savings account at the end of these 8 years?

Record your answer and fill in the bubbles on your answer document. Be sure to use the correct place value.

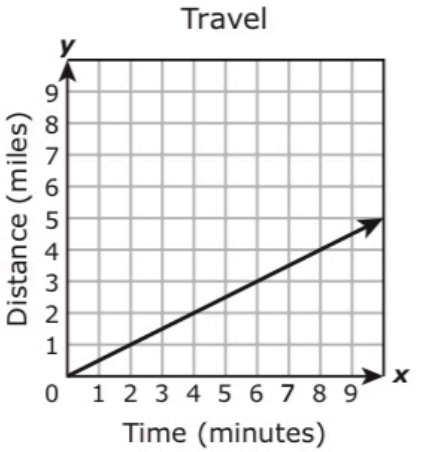
---

39 A student traveled a distance of 68 miles in 136 minutes. Which graph has a slope that best represents this rate?

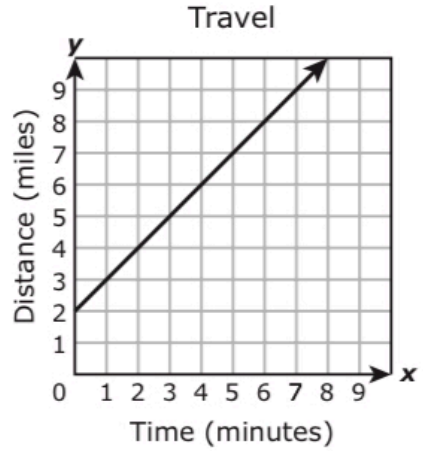
A



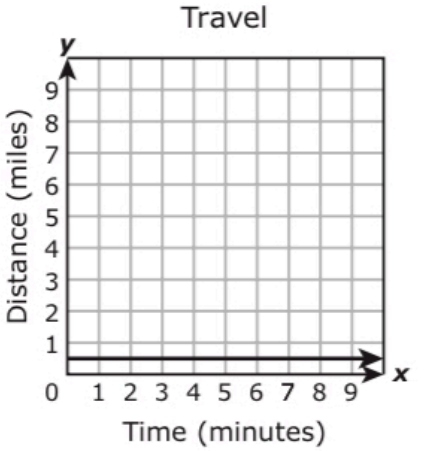
C



B



D



40 The cost for electricity varies directly with the amount of kilowatt-hours of electricity used. The cost for using 1,079 kilowatt-hours of electricity was $129.48.

What was the cost for using 908 kilowatt-hours of electricity?

F $41.52

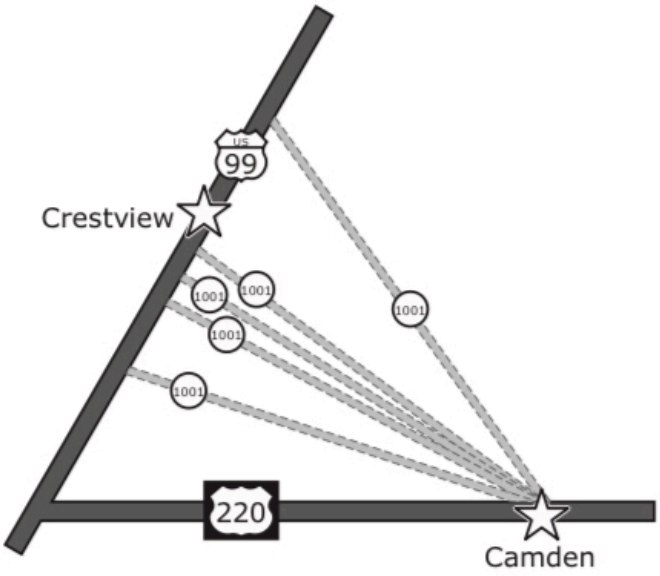
G $153.86

H $75.67

J $108.96

41 The map shows five proposed routes and distances for a new state highway between Camden and U.S. Highway 99.

Proposed Routes for State Highway 1001



Distances for Different Proposed Routes (km)
$\frac{675}{16}$
40
$\sqrt{2,111}$
$\frac{586}{13}$
$10\sqrt{17}$

Which list shows these distances from least to greatest?

A $10\sqrt{17}, 40, \frac{586}{13}, \frac{675}{16}, \sqrt{2,111}$

B $40, 10\sqrt{17}, \frac{675}{16}, \frac{586}{13}, \sqrt{2,111}$

C $\frac{586}{13}, \frac{675}{16}, 10\sqrt{17}, \sqrt{2,111}, 40$

D $40, \frac{675}{16}, \frac{586}{13}, \sqrt{2,111}, 10\sqrt{17}$

42 Which situation can be represented by this equation?

$$18x = 19 + 12x$$

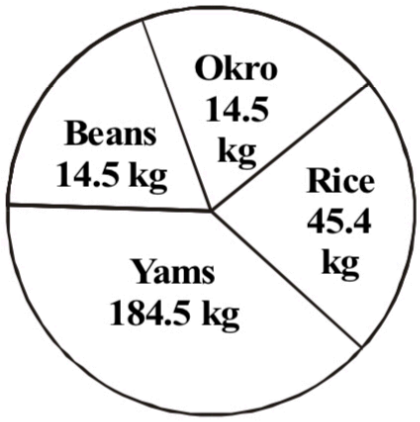
F Krystal reads 12 pages per hour. Jondo reads 18 pages per hour. How many hours, x, would it take for Krystal and Jondo to read the same number of pages?

G Krystal paid a deposit of \$19 plus \$18 per hour to rent a dining room at a restaurant. Jondo paid \$12 per hour to rent a dining room at a restaurant. How many hours, x, would it take for Krystal and Jondo to pay the same amount of money?

H Krystal installs 12 tiles per hour. Jondo installs 19 tiles per hour and started with 18 tiles already installed. How many hours, x, would it take for Krystal and Jondo to install the same number of tiles?

J Krystal can make \$18 per hour by tutoring. Jondo can make \$12 per hour by tutoring. Jondo already has \$19. How many hours, x, would Krystal and Jondo need to tutor for them to have the same amount of money?

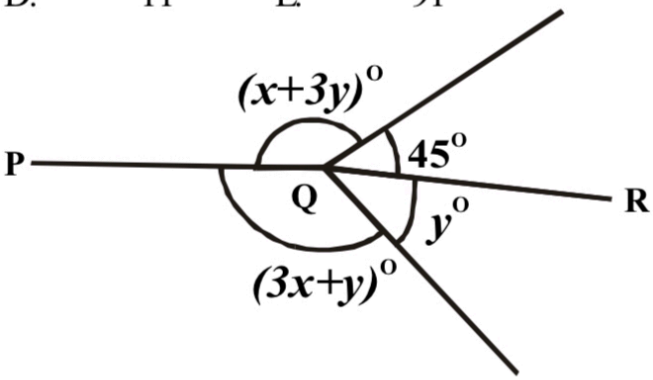
43.



The farm yields of four crops on a piece of land in Ondo are represented on the pie chart above. What is the angle of the sector occupied by Okro in the chart?

A. $91^{1}/_{2}^{0}$ B. $19^{1}/_{3}^{0}$ C. $33^{1}/_{3}^{0}$
D. 11^{0} E. 91^{0}

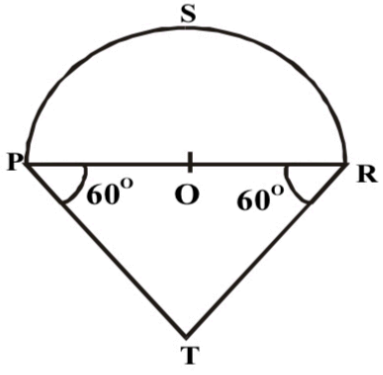
44.



In the figure above, PQR is a straight line. Find the values of x and y

A. $x = 22.5^0$ and $y = 33.75^0$
B. $x = 15^0$ and $y = 52.5^0$
C. $x = 22.5^0$ and $y = 45.0^0$
D. $x = 56.25^0$ and $y = 11.5^0$
E. $x = 18.^0$ and $y = 56.5^0$

45. PQR is the diameter of a semicircle RSP with centre at Q and radius of length 3.5cmc. if $QPT = QRT = 60^0$. Find the perimeter of the figure (PTRS p = 22/7)

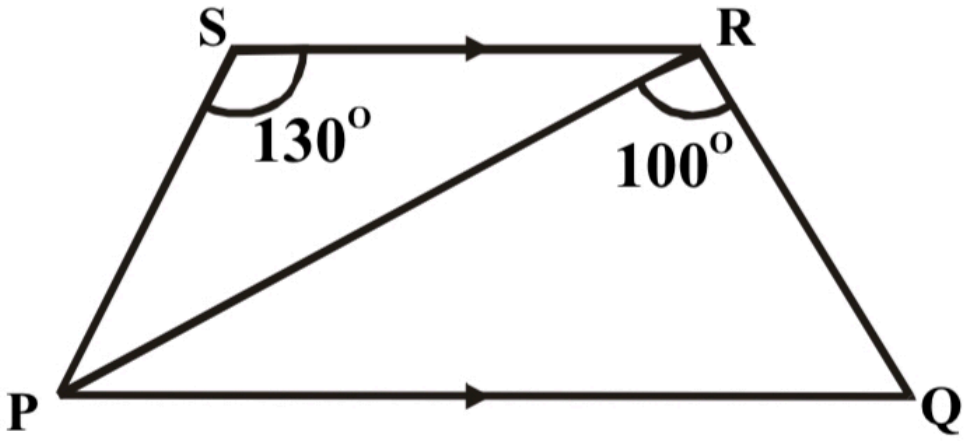


A. 25cm B. 18ccm C. 36cm
D. 29cm E. 25.5 cm

46. In a triangle PQR, QR = 3cm, PR = $\sqrt{3}$cm, PQ = $\sqrt{3}$cm and PQR = 30^0. find angles P and R

A. P = 60^0 and R = 90^0
B. P = 30^0 and R = 120^0
C. P = 90^0 and R = 60^0
D. P = 60^0 and R = 60^0
E. P = 45^0 and R = 105^0

47.



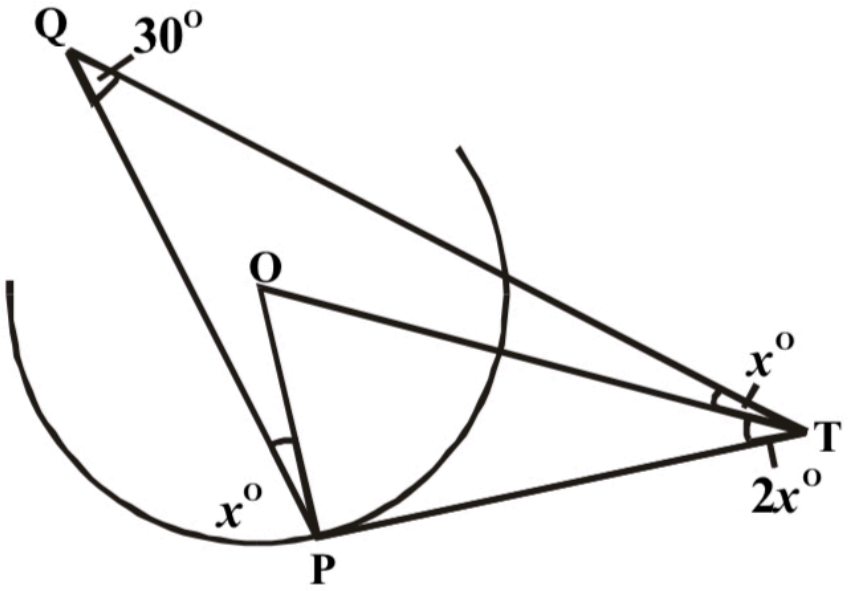
In the above diagram if PS = SR and PQ//SR. what is the size of PQR?

A. 25^0 B. 50^0 C. 55^0
D. 65^0 E. 75^0

48. Find the mean of the following 24.57,25.63,25.32,26.01,25.77

A. 25.12 B. 25.30 C. 25.26
D. 25.50q E. 25.73

49.



In the figure above PT is a tangent to the circle with centre O. if PQT = 30^0. find the value of PTO

A. 30_0 B. 15_0 C. 24^0

D. 12^0 E. 60^0

50 A man drove for 4hours at a certain speed, he then doubled his speed and drove for another 3 hours. Altogether he covered 600km. At what speed did he drive for the last 3 hours?

A. 120km/hr B. 60km/hr C. 600/7km/hr

D. 50km/hr E. 100km/hr.